NON-PUBLIC?: N
ACCESSION #: 89120080090
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Palo Verde Unit 2 PAGE: 1 OF 8

DOCKET NUMBER: 05000529

TITLE: Reactor Trip Due t Erroneous Power Level Signal
EVENT DATE: 10/31/89 LER #: 89-010-00 REPORT DATE: 11/30/89

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000529

OPERATING MODE: 1 POWER LEVEL: 067

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Timothy D. Shriver, Compliance Manager

TELEPHONE: 602-393-2521

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: IG COMPONENT: HS MANUFACTURER: G223
REPORTABLE NPRDS: N

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

At approximately 1646 MST on October 31, 1989, Palo Verde Unit 2 was in Mode I (POWER OPERATION), operating at approximately 67 percent power when a reactor trip occurred which resulted from a low Departure from Nucleate Boiling Ratio (DNBR) trip signal. The DNBR trip signal was caused by an erroneous power level input from the middle excore detector to the Channel "B" Core Protection Calculator. The trip was uncomplicated and secondary plant responses were within design throughout the event. No other safety system responses occurred and none were required. At approximately 1656 MST on October 31, 1989, the plant was stabilized in Mode 3 (HOT STANDBY) at normal temperature and pressure.

The cause of the erroneous middle excore detector input power level signal to the Channel "B" Core Protection Calculator is suspected to be an intermittent malfunction of the Channel "B" excore linear calibrate

switch.

As interim corrective action, a temporary modification has been installed to bypass the normal operating functions of the linear calibrate switch. As corrective action to prevent recurrence, engineering is developing a permanent solution.

There have been no previous similar occurrences reported pursuant to 10CFR50.73.
END OF ABSTRACT

I. DESCRIPTION OF WHAT OCCURRED:

A. Initial Conditions:

At approximately 1646 MST on October 31, 1989, Palo Verde Unit 2 was in Mode 1 (POWER OPERATION) at approximately 67 percent power.

B. Reportable Event Description (Including Dates and Approximate Times of Major Occurrences):

Event Classification: An event that results in manual or automatic actuation of the Reactor Protection System

At approximately 1646 MST on October 31, 1989, a reactor (RCT)(AC) trip resulting from a low Departure from Nucleate Boiling Ratio (DNBR) trip signal occurred. The DNBR trip signal was caused by an erroneous power level input from the middle excore detector (DET)(IG) to the Channel "B" Core Protection Calculator (CPU)(JC). The trip was uncomplicated and secondary plant responses were within design throughout the event. No other safety system responses occurred and none were required. At approximately 1656 ' MST on October 31, 1989, the plant was stabilized in Mode 3 (HOT STANDBY) at normal temperature and pressure.

The excore detectors provide neutron power level input to the Core Protection Calculators. Each excore detector channel is made up of three (3) detectors (upper, middle, and lower). The Core Protection Calculators use the neutron power input from the excore detectors to calculate DNBR and Local Power Density (LPD). When the Core Protection Calculator calculates a low

DNBR or high LPD condition, it generates a trip signal to the Plant Protection System (JC). The Plant Protection System has a two-out-of-four trip logic thus requiring DNBR trip signals from two Core Protection Calculator Channels to initiate a reactor trip.

Prior to the event, at approximately 1738 MST on October 30, 1989, Palo Verde Unit 2 was in Mode 1 during a plant startup at approximately 9 percent power when operations personnel (utility, licensed) noted that the middle excore detectors input to the Channel "B" and "D" Core Protection Calculators were reading zero. Both channels were declared inoperable. APS personnel (utility, licensed and non-licensed) investigated the malfunction of the middle excore detector circuits in accordance with an engineering evaluation which had previously addressed this problem. The malfunction of the middle excore detector input to the Channel "B" Core Protection Calculator was corrected based on the corrective actions delineated by the engineering evaluation. The malfunction of the middle excore detector input to the Channel "D" Core

Protection Calculator could not be corrected. At approximately 1800 MST on October 30, 1989 the Channel "B" Core Protection Calculator was returned to an OPERABLE status. The Channel "D" Core Protection Calculator remained inoperable in the bypass condition and a work request was initiated and the plant startup was continued.

Subsequently, at approximately 1246 MST on October 31, 1989, with Unit 2 in Mode 1 at 54 percent power, the Channel "C" Core Protection Calculator initiated a low DNBR and high LPD trip signal which immediately reset. Channel "C" Core Protection Calculator was declared inoperable. The Channel "D" Low DNBR and High LPD parameters were taken out of bypass and placed in trip. The Channel "C" Low DNBR and high LPD parameters were placed into bypass to allow recovery of the Channel "C" trip buffer and allow investigation of the problem. During recovery of the trip buffer, the Channel "C" Core Protection Calculator again initiated a low DNBR and high LPD trip signal which was caused by a malfunction of the RCP (P)(AB) 1A speed sensor (JC). Channel "C" Core Protection Calculator remained in bypass to allow troubleshooting of the RCP speed sensor. Channel "D" Core Protection Calculator remained in the "tripped" condition. This configuration (i.e., one channel in

trip, one channel in bypass) effectively resulted in the plant being in a one-out-of-two trip logic.

At approximately 1646 MST on October 31, 1989, the middle excore detector circuitry which provides an input to the Channel "B" Core Protection Calculator malfunctioned resulting in a zero power signal to the Core Protection Calculator. Based on this input, the Channel "B" Core Protection Calculator determined that a low DNBR condition existed and generated a low DNBR trip signal to the Plant Protection System. This completed the Plant Protection System trip logic resulting in a reactor trip.

Plant response was normal. Operations personnel (utility, licensed) diagnosed the event as an uncomplicated reactor trip. At approximately 1656 MST on October 31, 1989, the plant was stabilized in Mode 3 at normal temperature and pressure. There were no Engineered Safety Features responses or actuations and none were necessary.

C. Status of structures, systems, or components that were inoperable at the start of the event that contributed to the event:

As described in Section I.B, the Channel "C" Core Protection Calculator was in bypass to allow troubleshooting of the reactor coolant pump 1A speed sensor. The Channel "D" Core Protection Calculator was in a tripped condition due to a malfunction in the

middle excore detector input.

D. Cause of each component or system failure, if known:

The cause of the erroneous input power level signal from the middle excore detector to the Channel "B" Core Protection Calculator described in Section I.B is suspected to be an intermittent malfunction of the Channel "B" excore linear calibrate switch (HS) (IG). This is based on previous root cause of failure analysis performed on the circuit and the troubleshooting performed after this event.

Prior to this event, root cause of failure analyses have been performed for each observed malfunction of the linear calibrate

switches. None of the previous malfunctions involved an observable component failure. The switches that first experienced this type of malfunction were replaced and sent to the manufacturer for root cause of failure analysis. The manufacturer concluded that the style of switch is marginal for the application. The switch was designed to have a small amount of arcing occur across the contacts when the switch was rotated through the various switch positions. The resultant arcing would provide sufficient cleaning of the switch contacts so that a significant amount of corrosion buildup would not occur. The application for which the switches are currently being used does not provide sufficient electrical current to allow the arcing to occur. Therefore, APS engineering has recommended that the switches be rotated several times when a malfunction is observed. This recommendation is an interim solution while a permanent plant design change is developed.

Troubleshooting was performed on the circuit to ensure that no other component failure had occurred. No other component failures were found on Channel "B" as a result of this troubleshooting.

The cause of the reactor coolant pump speed sensor malfunction described in Section I.B has been determined to be an internal short in the speed probe (JC) at the pump. Troubleshooting also found that one other speed probe displayed a degraded signal. This was due to an improperly sealed connector within the speed probe. Except a
noted above, the shorts and
improperly sealed connector only resulted in a degraded signal being received by the Core Protection Calculators. The degraded signals were adequate to provide an input to the Core Protection Calculators and therefore did not contribute to the event.

Additional troubleshooting of other RCP speed sensor circuits found that, for several speed sensor signal transmitters, metal identification tags provided a path to ground interfering with the transmitters output. The transmitters have metal identification

tags installed on the transmitter body using the mounting bolts for the transmitters. No other grounds were identified that would interfere with the speed sensor output.

The cause of the erroneous input signal from the middle excore detector to the Channel "D" Core Protection Calculator described in Section I.B has been determined to be an open in the cable connector (CON)(JC) attaching the middle excore detector input to the Power Range Drawer.

E. Failure mode, mechanism, and effect of each failed component, if known:

The intermittent malfunction of the Channel "B" excore linear calibrate switch resulted in a zero power signal to the Channel "B" Core Protection Calculator. Based on the low power signal and resulting effect on power distribution calculations, the Core Protection Calculator sent a low DNBR trip signal to the Plant Protection System. This resulted in a reactor trip as described in Section I.B. The malfunction of the reactor coolant pump speed signal resulted in a low flow signal to the Channel "C" Core Protection Calculator. The Core Protection Calculator generated a low DNBR and high LPD trip signal to the Plant Protection System.

The malfunction of the cable connector in the middle excore detector input signal resulted in a zero power signal to the Channel "D" Core Protection Calculator generating a low DNBR trip signal to the Plant Protection System. Due to these malfunctions, one channel was placed in bypass and one channel was placed in the tripped condition. This resulted in the Plant Protection System being in a one-out-of-two trip logic for low DNBR and high LPD as described in Section I.B.

F. For failures of components with multiple functions, list of systems or secondary functions that were also affected:

Not applicable - No component failures had multiple functions which affected other systems or components.

G. For failures that rendered a train of a safety system inoperable, estimated time elapsed from the discovery of the failure until the train was returned to service:

There were no failures that rendered a train of a safety system inoperable.

H. Method of discovery of each component or system failure or procedural error:

The suspected intermittent malfunction of the Channel "B" excore linear calibrate switch was discovered as a result of troubleshooting performed after the event and previous root cause of failure analysis performed on the circuit.

The malfunction of the speed probe in reactor coolant pump 1A was discovered as a result of troubleshooting performed after the event.

The open in of the connector in the input circuit to the Channel "D" Core Protection Calculator was discovered as a result of troubleshooting performed after the event.

I. Cause of Event:

The cause of the reactor trip discussed in Section I.B was a combination of unrelated malfunctions on three (3) independent Core Protection Calculator Channels as follows:

1. An intermittent malfunction of the Channel "B" excore linear calibrate switch.

2. A malfunction of the speed probe in reactor coolant pump 1A.

3. A malfunction of the connector in the input circuit to the Channel D" Core Protection Calculator.

The cause of these malfunctions is described in Section I.D.

J. Safety System Response:

There was a reactor trip resulting from a low DNBR trip signal to the Plant Protection System as described in Section I.B. No other safety system responses occurred and none were required during this event.

K. Failed Component Information:

The linear calibrate switch is manufactured by Grayhill Incorporated and is part number 44A30-05-2-03N.

The cable connector is manufactured by Amphenol and is Milspec

number 39012/16-0015.

The speed probe is manufactured by Bentley Nevada Corporation and is model number 37034-01.

II. ASSESSMENT OF THE SAFETY CONSEQUENCES AND IMPLICATIONS OF THIS
EVENT:

The reactor trip was uncomplicated. All safety systems performed within design. The event did not result in any challenges to fission product barriers or result in any releases of radioactive materials. Therefore, there were no safety consequences or implications as a result of this event. This event did not adversely affect the health and safety of the public.

III. CORRECTIVE ACTIONS:

A. Immediate:

1. Linear Calibrate Switch

An engineering evaluation has been performed and APS has determined that the linear calibrate switch is not required for plant operation. During operation, the linear calibrate switch is used for routine surveillance testing. Therefore, a temporary modification has been installed to bypass the normal operating functions for the linear calibrate switches in all Unit 2 channel excore drawers. The new testing method based on this temporary modification has also been incorporated into appropriate procedures.

2. Speed Sensors

a. The speed probe with the internal short has been replaced.

b. The improperly sealed connector within the speed probe was reworked and retested satisfactorily.

c. The metal tags were removed from the speed signal transmitters.

3. Cable Connector

The faulty cable connector has been replaced.

B. Action to Prevent Recurrence:

1. Engineering is developing a permanent solution to resolve the linear calibrate switch problem. This is expected to be completed by January 31, 1990.

2. A procedure change will be implemented for all three units to ensure that the reactor coolant pump speed sensors are checked for grounds and the speed sensor circuits are at

nominal values each refueling outage. Units 1 and 3 personnel will also check for grounds in the reactor coolant pump speed sensors and verify the speed sensing circuits are at nominal values prior to startup from their current outages.

3. An evaluation of the possible methods to ensure continuity of the detector cable and associated connectors following maintenance or testing activities is in progress. The evaluation is expected to be completed and methodology developed by December 15, 1989 for all three units.

4. An evaluation of the need to implement the temporary modification to bypass the normal operate functions for the linear calibrate switch is being conducted to determine what interim course of action is required for Units 1 and 3. This evaluation and any actions resulting from the evaluation will be completed prior to startup from the current outages for Units 1 and 3.

IV. PREVIOUS SIMILAR EVENTS:

There have been no previous similar occurrences reported pursuant to 10CFR50.73. There have been previous reactor trips reported. However, none of the previous reactor trips were attributable to the same root cause described in Section I.I. Therefore none of the previous corrective actions would have been expected to prevent this event.

Arizona Public Service Company
PAL
VERDE NUCLEAR GENERATING STATION
P.O. BOX 52034 - PHOENIX, ARIZONA 85072-2034

192-00554-JML/TDS/RKR
November 30, 1989

JAMES M. LEVINE
VICE PRESIDENT
NUCLEAR PRODUCTION

U. S. Nuclear Regulatory Commission
NRC Document Control Desk
Washington, D.C. 20555

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 2 Docket No. STN 50-529 (License No. NPF-51)
Licensee Event Report 89-010-00
File: 89-020-404

Attached please find Licensee Event Report (LER) No. 89-010-00 prepared and submitted pursuant to 10CFR 50.73. In accordance with 10CFR 50.73(d), we are herewith forwarding a copy of the LER to the Regional Administrator of the Region V office.

If you have any questions, please contact T. D. Shriver, Compliance Manager at (602) 393-2521.

Very truly yours,

JML/TDS/RKR/kj

Attachment

cc: W. F. Conway (all w/a)
E. E. Van Brunt
J. B. Martin
T. J. Polich
M. J. Davis
A. C. Gehr
INPO Records Center

*** END OF DOCUMENT ***